Energy Efficiency and Renewable Energy
Federal Energy Management Program

How to Buy an Energy-Efficient Residential Air-Source Heat Pump

Why Agencies Should Buy Efficient Products

- *Executive Order 13123 and FAR Part 23 direct agencies to purchase products in the upper 25% of energy efficiency, including all models that qualify for the EPA/DOE* ENERGY STAR® *product labeling program.*
- *Agencies that use these guidelines to buy efficient products can realize substantial operating cost savings and help prevent pollution.*
- *As the world's largest consumer, the federal government can help "pull" the entire U.S. market towards greater energy efficiency, while saving taxpayer dollars.*

For More Information:

- DOE's Federal Energy Management Program (FEMP) Help Desk and web site have up-to-date information on energy-efficient federal procurement, including the latest versions of these recommendations.
  Phone: (800) 363-3732
  www.eren.doe.gov/femp/procurement
- Environmental Protection Agency has maintains a database of heat pumps that comply with the ENERGY STAR® specification found in this recommendation.
  Phone: (888) 782-7937
  www.energystar.gov/products
- American Council for an Energy-Efficient Economy (ACEEE) publishes the *Consumer Guide to Home Energy Savings.*
  Phone: (202) 429-0063
- Consortium for Energy Efficiency (CEE) has utility programs promoting energy-efficient heat pumps and publishes the *Specification of Energy-Efficient Installation and Maintenance Practices for Residential HVAC Systems.*
  Phone: (617) 589-3949
  www.cee1.org
- Air Conditioning Contractors of America (ACCA) publishes *Manual J*, a load calculation guide for residential heating and air conditioning, and *Manual S*, a sizing guide for heating and cooling equipment.
  Phone: (202) 483-9370
  www.acca.org
- *Home Energy* Magazine provides energy conservation tips.
  Phone: (510) 524-5405
  www.homeenergy.org
- Lawrence Berkeley National Laboratory (LBNL) provided supporting analysis for this recommendation.
  Phone: (202) 646-7950

Efficiency Recommendation[a]

Product Type	Recommended	Best Available[b]
Split Systems	8.0 or more HSPF 11.0 or more EER 13.0 or more SEER	9.6 HSPF 14.9 EER 17.4 SEER
Single Package[c]	7.6 or more HSPF 10.5 or more EER 12.0 or more SEER	8.3 HSPF 12.0 EER 15.6 SEER

a) This efficiency recommendation meets ENERGY STAR specification effective October 1, 2002 (see "For More Information").

b) The best available HSPF, SEER, and EER may apply to different models.

c) Single package gas and electric units are covered here. This recommendation excludes window units and other ductless systems.

Definitions

HSPF (Heating Seasonal Performance Factor) is the total heating output (in Btu) provided by the unit during its normal annual usage period for heating divided by the total energy input (in Wh) during the same period.

EER, or Energy Efficiency Ratio, is the cooling capacity (in Btu/hour) of the unit divided by its electrical input (in watts) at ARI standard peak rating condition of 95°F.

SEER (Seasonal Energy Efficiency Ratio) is the total cooling output (in Btu) provided by the unit during its normal annual usage period for cooling divided by the total energy input (in Wh) during the same period.

How to Select an Energy-Efficient Heat Pump

For heat pumps purchased through commercial sources, specify ENERGY STAR models meet or exceed this Efficiency Recommendation. Alternatively, look at the yellow "EnergyGuide" label to identify models with an HSPF and SEER that meet or exceed this recommendation. If utility peak demand charges are a concern, buyers should specify this recommended EER, which is a better measure of determining peak loads.

When to Choose a Heat Pump

Heat pumps operate very inefficiently at sub-freezing temperatures, so should be avoided as stand-alone heating systems in cold climates. However, they will always offer energy savings over straight electric resistance heating coupled with central air conditioning. In climates with mild winters, heat pumps may provide cost-effective heating when compared with gas or oil furnaces, depending on relative utility costs.

Sizing

Oversizing of heat pumps, besides raising purchase cost, will result in weaker energy efficiency, poorer humidity

control, and shorter product life, all due to excessive on-off cycling. The required heat pump capacity should be determined based on the referenced ACCA calculation procedures (see "For More Information"). Special attention should be paid to identifying the heating and cooling capacity separately, since these may vary.

Installation and User Tips

Leaky ductwork is a particular problem with heat pumps since heat losses will cause the electric resistance heat to operate much more frequently; consider duct sealing with heat pump installation. Choosing and setting controls properly helps prevent energy losses with heat pumps; careful attention should be paid to minimizing operation of the electric resistance heat. Consider leaving your heat pump off during unoccupied hours, or using a set-back thermostat to minimize unnecessary operation of the unit. However, precaution should be taken in heating seasons to make sure this strategy does not trigger excessive use of back-up heating. CEE has published specifications for installation and maintenance of energy efficient residential air conditioning systems (see "For More Information").

Environmental Tips

Refrigerants with ozone-destroying chlorofluorocarbons (CFCs) were used many years ago in heat pumps, but almost all equipment on the market today uses HCFC refrigerants, which have a much lower ozone-depleting effect. There are some heat pump models now on the market that use refrigerants with no ozone-depleting effect; ask your supplier for information. When retiring a heat pump that contains CFCs or HCFCs, the Clean Air Act requires that the refrigerant be recovered on-site by a certified technician. For compliance information, contact the EPA Stratospheric Ozone Information Hotline at (800) 296-1996.

Heat Pump Cost-Effectiveness Example
(36,000 Btu/hour – 3 tons single packaged)

Performance	Base Model[a]	Recommended Level	Best Available
HSPF / EER / SEER	6.8 / 9.5 / 10.0	7.6 / 10.5 / 12.0	8.3 / 12.0 / 15.6
Annual Energy Use	12,500 kWh	10,800 kWh	8,000 kWh
Annual Energy Cost	$750	$650	$480
Lifetime Energy Cost	$8,100	$7,000	$5,200
Lifetime Energy Cost Savings	–	*$1,100*	*$2,900*

a) The HSPF and SEER efficiency of the Base Model is just sufficient to meet current U.S. DOE national standard. The EER of the Base Model shown represents the most common model on the market. HSPF, SEER, and EER may apply to different models.

Definition

Lifetime Energy Cost is the sum of the discounted value of annual energy costs based on average usage and an assumed heat pump life of 15 years. Future electricity price trends and a discount rate of 3.2% are based on federal guidelines (effective from April, 2002 to March, 2003). The average (federal) electricity price (including demand charges) is 6¢/kWh.

Cost-Effectiveness Assumptions

Annual energy use is based on average operating conditions in Charleston, South Carolina – an typical area for a heat pump with a heating and cooling capacity of 36,000 Btu/h – approximately 1,400 heating load hours and 1,400 cooling load hours. Since the heating mode is less efficient than the cooling mode, about 60% of a heat pump's operating costs are due to heating energy (despite roughly equal heating and cooling load hours).

Metric Conversion

1,000 Btu/h = 293 Watts
*°F = (1.8 * °C) + 32*

Using the Cost-Effectiveness Table

In the example above, this (3-ton, single packaged) heat pump with an HSPF of 7.6, an EER of 10.5, and a SEER of 12.0 is cost-effective if its purchase price is less than $1,100 above the price of the Base Model. The Best Available model, with an HSPF of 8.3, an EER of 12.0, and a SEER of 15.6 is cost-effective if its price is less than $2,900 above the price of the Base Model.

What if my Electricity Price, Capacity, or Load Hours are different?

Estimating Lifetime Energy Costs for different conditions can be difficult with heat pumps. ENERGY STAR has developed a web based tool that can be helpful. Go to http://www.epa.gov/nrgystar/purchasing/calculators/ashp-main.html.